

with the Author's

LESIONS OF THE SPINAL CORD, THE RESULT OF  
ABSORPTION FROM LOCALISED SEPTIC FOCI,  
WITH A PRELIMINARY NOTE ON AN EXPERI-  
MENTAL RESEARCH

12

BY

DAVID ORR, M.D., AND R. G. ROWS, M.D.



Reprinted from *Review of Neurology and Psychiatry*, January 1906

*Edinburgh & London*



I enclose a reprint of  
a short paper which  
Dr. Orr & I have just published.

Yours sincerely

W. L. Rous.



# County Lunatic Asylum,

LANCASTER.

27 January 1906.

Dear Mr. Tweedy,

I beg to thank  
you for again signing  
my forms of application  
for a licence to operate  
on dogs.

The results which Dr. Orr  
have so far obtained in  
rabbits are fairly satisfactory  
& support the opinions  
expressed last year.

## LESIONS OF THE SPINAL CORD, THE RESULT OF ABSORPTION FROM LOCALISED SEPTIC FOCI, WITH A PRELIMINARY NOTE ON AN EXPERIMENTAL RESEARCH.<sup>1</sup>

By DAVID ORR, M.D., and R. G. ROWS, M.D.

IN a paper published in the Winter number of *Brain*, 1904, while discussing the starting-point and distribution of posterior column lesions in General Paralysis of the Insane, we referred to the work which has been done to determine the course of the lymph stream in the posterior roots and columns, and we stated that it has been proved by several observers that the lymph flows in an ascending direction towards the cord.

A reference to this paper (1) will show the reasons for adopting this view. The object of our present communication is to bring forward further definite evidence in favour of the theory that lesions of the spinal cord can be produced by the ascent of toxins, or in some cases even of organisms, from peripheral foci of inflammation, either of an acute or a chronic nature.

The series, from which our conclusions have been drawn, comprises in all eight cases, which are mentioned in the table below. The lesions were of varying nature and situated in different parts of the body, and in each case, as a reference to the table will show, the cord lesion was found to be much more intense in the segments of the cord corresponding to the nerve supply of the affected area.

---

CASE 1. Bedsores ; gluteal region ; more severe on left side ; sup-puration of right elbow.

Degeneration of the posterior columns and of the anterior radicular fibres in the lumbo-sacral region from S 1 to L 3 ; more intense on the left side and in 4th lumbar. From D 12 to D 2 there was nothing worthy of note. Degeneration again commenced at D 1 on the right side ; the lesion was most marked in C 7 and 6, and gradually diminished in the next few segments.

---

<sup>1</sup> An account of this research will form the subject of a separate paper. Towards the expenses of this research we have received a grant from the British Medical Association.

CASE 2. Left brachial neuritis ; staphylococci in the tissues around the posterior root ganglia.	Marked degeneration of the left root-entry zone and Burdach's column from C 8 to C 2 ; maximum in C 7-6 ; faded gradually from C 6 upwards. Degeneration also present in the lateral region and anterior radicular zones. Right half of cord affected similarly, but to a markedly less extent. There were no changes in the anterior or posterior roots.
CASE 3. Bedsores on buttocks and sacrum ; of longer duration on the right side.	Lesion most intense on the right side. Some degeneration of posterior columns in S 1 ; maximum at the level of L 4-3 ; diminished gradually in the segments above this.
CASE 4. Pelvic cellulitis ; renal abscesses ; double empyema, of longer duration on the left side ; abscess in the cervical muscles ; no peritonitis.	Very slight degeneration of the posterior columns in the sacral region. Much Marchi reaction amongst the anterior radicular fibres of S 4-3-2, especially on the left side. No changes in the lumbar cord. Degeneration in the root-entry zones of D 11-10-9 ; again a separate lesion beginning in D 5 occupying the same area, more marked on the left side, and occurring in every segment as high as C 4. In cervical region degeneration greatest in C 7-6.
CASE 5. Caries of the 4th and 5th lumbar vertebræ ; psoas abscess on the right side. The abscess cavity became septic two months before death.	In S 2 a slight lesion of the posterior columns. This increased in S 1, and was most intense in L 5-4. Above this level it gradually diminished. Lesion much more marked on the right side.
CASE 6. Chronic suppuration of the right knee-joint.	Degeneration from S 1 to the lower dorsal region ; most marked in the right posterior columns and most intense in L 4-3-2.
CASE 7. Chronic suppuration of the left knee-joint.	Lesion of the posterior columns slight in S 1 ; well marked in L 5-4-3. It ceased at D 11 ; most intense on the left side. There were no changes in the left sciatic nerve.
CASE 8. Prostatic disease ; chronic cystitis.	Followed by transverse myelitis at the level of D 8-9.

An examination of the spinal cords from the above-mentioned cases has enabled us to confirm the two points insisted on before, viz. that system degenerative lesions of the sensory protoneurons always begin at the point where the fibres entering the cord lose their neurilemma sheath, and spread thence into the posterior



columns ; that such lesions in their early stages, and even for a prolonged period, exist without any appreciable changes in the posterior roots.

It is now generally admitted that the posterior column lesions in early Tabes, and in other conditions, such as Diabetes and General Paralysis of the Insane, are primary, and not dependent upon any lesion of the posterior roots, or of the posterior root ganglion cells.

But besides defining the starting-point of these degenerations, our series of cases seems to show clearly, by the distribution of the lesions in the cord, that the changes are the direct result of absorption from some peripheral septic focus. For example, in Case 1, with bed-sores, which were more severe on the left side, the lumbo-sacral enlargement showed considerable degeneration, whereas the dorsal region was almost entirely free. In Fig. 1, note the greater degree of degeneration on the left side ; in Fig. 2 only the centre of the posterior columns shows a few scattered fibres. Further, in the same case, corresponding to a suppuration of the right elbow-joint, there was a marked degeneration of the cervical enlargement, which was more intense on the right side (Fig. 3). Case 2 exhibited the same localised and limited distribution, but on the left side (Fig. 5).

There is evidence, however, that, although the toxins are carried along the perineural sheath into the corresponding posterior column, a certain quantity of the toxic lymph spreads along the loose meshes of the pia mater to the opposite posterior column, and also in a lateral direction to the adjacent portions of the cord (Figs. 3 and 5).

Further, we have found that toxins are carried along the perineural sheath of the motor roots as well, but the resulting degeneration is never so intense as in the posterior columns.

Homen's<sup>1</sup> observation that toxins seem to reach the spinal cord more readily by the posterior than the anterior roots is interesting in this connection. A possible explanation may be found in the fact that the posterior roots are nearly three times as large as the anterior, and can therefore pour a larger quantity of lymph into the cord in a given time.

The degeneration amongst the anterior radicular fibres, as in the case of the posterior roots, commences at the cord margin

<sup>1</sup> Referred to *Brain*, Winter 1904.

where the neurilemma sheath is lost, and affects only the intramedullary portion. We therefore consider this point just as vulnerable to the action of toxins ascending in the perineural lymph stream as the corresponding one on the sensory proto-neuron system. From the point where the anterior roots enter the cord, some of the lymph, instead of passing along the radicular fibres towards and into the grey matter, diffuses laterally, and produces a degeneration of the fibres in the adjacent regions.

There is one other fact to be mentioned, and that is, that in all our cases we have constantly observed degeneration amongst the fibres of the anterior commissure, but only in those segments which exhibit the lesions described above.

The effect of the lateral diffusion of the toxic lymph referred to above is best seen in Case 2, Fig. 5. From this case—brachial neuritis of infective origin—it seems highly probable that this diffusion from the two points of maximum intensity occurs more readily when the toxins are present in greater quantities, or when they possess a higher grade of virulence. We have failed to find evidence of it in milder degrees of toxicity, such as are associated with bedsores.

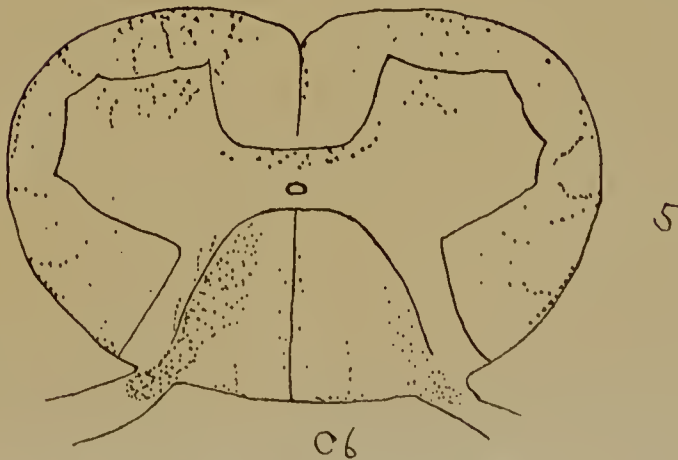
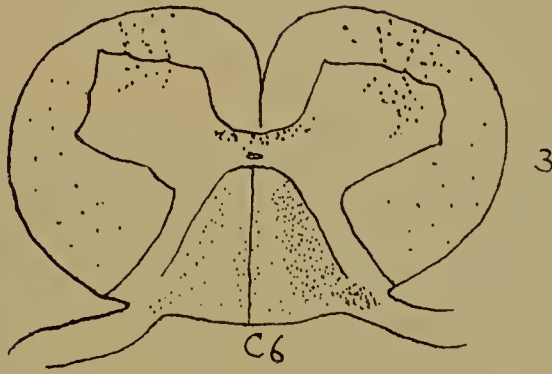
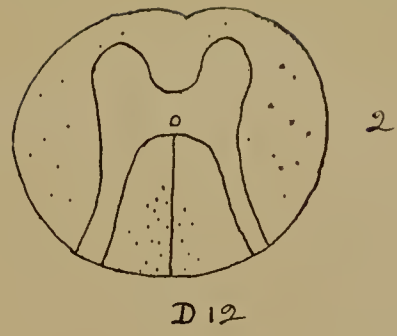
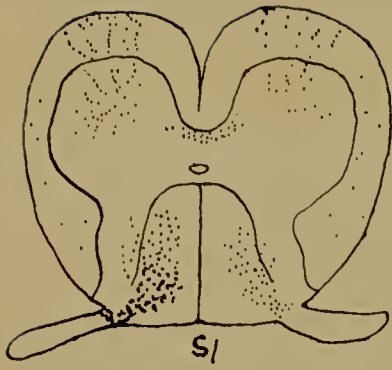
Fig. 5 shows the distribution of the lesion in Case 2 as it is demonstrated by the Marchi method.

The degeneration of the posterior columns began at the point where the fibres lose their neurilemma sheath, and spread forwards into the root-entry zone. Amongst the anterior radicular fibres also there was much reaction, which extended from the cord margin, where these fibres also lose their neurilemma sheath. In addition, the diagram shows considerable degeneration around the margin of the cord and along the pial prolongations dipping into the lateral tracts.

The degenerations in the anterior part of the cord, although present elsewhere, have been most clearly seen and followed even to the cell groups of the grey matter, in the upper sacral and lumbar regions.

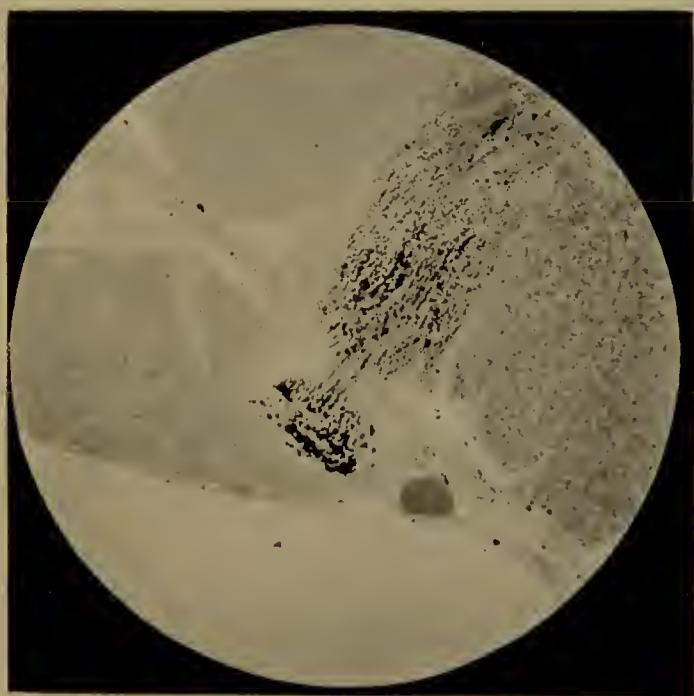
After running up to the cell groups, the degenerated fibres encircle them, and change their position with them (Fig. 4). For example, in the sacral region, where the motor cells occupy a postero-lateral position, the degenerated fibres travel through almost the whole depth of the anterior cornu to reach them ;





To show the distribution of Marchi reaction.







while at a higher level, where the cells lie more anteriorly, the Marchi reaction is chiefly confined to this region.

It will thus be seen that there are two paths by which the lymph enters the cord from the periphery, and two points especially open to attack. It is at these two points that we find the maximum amount of degeneration of the nerve fibres, while there is a less severe affection of the fibres in the adjacent regions.

We have recently examined the cord of a case of myelitis, which occurred in the course of a septic cystitis. The myelitic focus was situated in the 8th and 9th dorsal segments, and the distribution of the maximum degeneration suggested strongly to us that the myelitis was the result of absorption from the bladder. We found on examination by the Marchi method that the posterior columns showed most change, while the postero-lateral region was affected to a somewhat less extent. In each anterior radicular zone there was a well-defined patch of degeneration. The more lateral region and the grey matter exhibited only a limited and scattered lesion.

This case, while it differed ætiologically from the others of our series, is highly suggestive of an organismal infection from the bladder, because of the distribution of the myelitic patches in the entry zones of the anterior and posterior roots.

Similar cases are recorded by Walker in the *Lancet* for March 11, 1905. He described three cases in which an acute ascending paralysis occurred in the course of chronic cystitis, and suggested as an explanation that the lesion of the cord was due to an extension of an inflammation along the nerves from the bladder to the cord. Now, all our observations tend to show that from any septic focus, wherever it may be situated, toxins, and in some cases organisms, can ascend to the cord, and there, for the first time, exert their noxious influence. We do not think it probable that the resulting lesion of the cord is due to a direct extension of the inflammatory process, because it is contrary to our experience to find the peripheral nerves or the spinal roots affected.

We therefore still adhere to the view which we have expressed before, that the toxins spread upwards in the perineural sheath without producing any reaction before the cord is reached. With the view of testing the validity of the opinions which we have enunciated in this paper, we have undertaken an experimental



research on animals. By means of these experiments we are able to provide a constant limited supply of toxins in the neighbourhood of some peripheral nerves or spinal roots. So far, the results which we have obtained have shown that the reaction produced in the spinal cord is not a continuation of changes in the nerves, and also that the lesion in the spinal cord commences at the two vulnerable points which we have dealt with above.

In conclusion, we have to thank Professor Lorraine Smith for many suggestions in connection with our work, and for his kindness in allowing us to carry on the experimental part of our research in his laboratory at Owen's College, Manchester.

#### REFERENCES.

1. Orr and Rows. *Brain*, Winter, 1904.
2. Walker. *Lancet*, March 11, 1905.